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(71) Applicant
Neville Hamilton Birch
12 Prince Rupert Mews, Lichfield, Staffs WS13 7DD,
United Kingdom

(72) Inventors
Neville Hamilton Birch

(74) Agent and/or Address for Service
Boult Wade & Tennant
27 Furnival Street, London, EC4A 1PQ,
United Kingdom

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(54) Emergency evacuation and guidance means.

(57) A means of assisting the evacuation of personnel in the event of fire or other emergency, particularly in transport vehicles, comprises a plurality of sensors positioned and adapted to detect at a plurality of locations unusual conditions and indicating an emergency state; data processing means adapted to receive and analyse signals from said sensors; and human sensory guidance means, such as audio and/or lighted visual signs, activated by signals transmitted by said data processing means to provide guidance to personnel for evacuation from or avoidance of, said emergency. Preferably the signals from two or more of said sensors are simultaneously compared by the data processor to verify the existence of the emergency and thereby reduce the risk of a false alarm.

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EMERGENCY EVACUATION AND GUIDANCE MEANS

This invention relates to emergency evacuation and guidance means, and in particular to means for assisting the evacuation of personnel in emergencies, and in particular fire emergencies, and generally for providing guidance in emergency situations.

In its broadest aspect the present invention provides means for assisting the evacuation of personnel from a structure or a transport vehicle in the event of a fire or other emergency or for guiding personnel to avoid the site of such an emergency, which means comprises a plurality of sensors positioned and adapted to detect unusual conditions at a plurality of locations indicating an emergency state; data processing means adapted to receive and analyse signals from such sensors; and human sensory guidance means activated by signals generated from said data processing means to provide guidance to personnel for evacuation from, or avoidance of, said emergency.

In a particularly preferred aspect the invention provides means for assisting the evacuation of personnel from a transport vehicle in the event of fire, which means comprises a plurality of sensors positioned externally and/or internally of said vehicle and adapted to detect unusual conditions of such parameters as temperature, gas concentrations, smoke or other parameters indicating a presence of, or risk of, fire and/or explosion; data processing means adapted to receive and analyse signals from said sensors; and human sensory guidance means activated by signals generated from said data processing means to provide guidance to personnel in

the evacuation of said vehicle.

The background of this invention is as follows.

The complexity of transport vehicles and transport systems, for example aviation and rail services, together with the on-board technical equipment required to operate, control and monitor said vehicles and systems requires decision-making which invariably has to be done by highly-experienced people. However, when a malfunction, or other life-threatening event, occurs the nature of the decisions required immediately is often beyond human competence. This is evidenced by the following example.

In the case of an aircraft accident it is impossible for the commander of the aircraft to be aware of all the relevant factors and what may follow as a result of decisions made in the absence of all relevant information.

In the notorious disaster at Manchester involving the survivable, but in the event fatal, accident to a Boeing 737 aircraft, the commander knew only that there was an engine malfunction accompanied by fire. The take off was aborted and the order was given to evacuate on the starboard side of the aircraft. The following events then occurred:

1. The rear starboard door was opened before the aircraft came to rest, the escape chute was deployed and was swept under the aircraft and destroyed by fire in less than two minutes.

2. The front starboard door jammed and vital time was lost in getting it to function.

3. The starboard overwing exit was obstructed by the seating arrangement by which time it was impossible to see the exits and panic and chaos ensued.

The actual situation in aircraft (and other

forms of transport) even though emergency demonstrations are given, is that passengers have only a limited knowledge of the evacuation procedure, and in large transport aircraft with many exits, these are poorly identified usually by the word(s) "exit" or "emergency exit", but otherwise blending unobtrusively with the cabin decor. Furthermore the exits may be screened or partitioned off either by class or classes and/or galley bulkheads, and while some passengers are seated adjacent or close to exits which can be seen, for the majority, exits are not readily identified since the nearest exit may be a row or two in front (or behind) but partitioned in the manner described. The farther away from an exit the greater the uncertainty there exists in exit identification, which may be further exacerbated by the presence of smoke and other hazards in an emergency situation.

The present arrangement is unsatisfactory since these emergency exits rely soley on unassisted visual means to gain access, rather than by making maximum use of human sensory perception. This then is the case before an emergency has occurred.

Following a malfunction, crash or impact resulting in fire, the nearest exit may be fire-affected and unuseable. The facts relating to the location of the external fire, its size, speed of development, the effect of ambient wind, etc. may be quite unknown to the captain of the aircraft whose decision to evacuate and by which exits and on which side is now no more than a "best guess". It is a purpose of this invention in the above situation to eliminate this uncertainty and identify the nearest safe exit and make the route to it apparent to passengers in the cabin of the aircraft.

One of the essential features of the present

invention is the provision of sensors. These may be in the simplest form be thermosensitive fuses that burn through or otherwise react at a given temperature. These are light and cheap to produce and may be placed internally or externally to suit requirements, and may be supplemented or combined with other sensors to detect smoke, pressure change or gases amongst a range of possible options.

These sensors are connected, preferably by a low capacity electrical circuit commensurate with emergency lighting or other alternative power source, to data processing means such as a computer or micro processor. This equipment is readily available and inexpensive, simple and lightweight.

In fundamental form the electrical or other communicating circuits used for implementing the invention can be built in during construction of the structure of transport vehicle, or may be added subsequently. Such circuitry may be in the form of optical fibres, wires, paint which is electrically conductive or electromagnetically etched into a surface, or may be contained in an adhesive tape which can be quickly affixed over long distances at minimal cost.

Another critical component of the present invention is the guidance means which is usually a light source which can be caused to illuminate in a variety of ways such as a static light strip, a dotted light source, a pulsing light, or a sequentially moving light display (with or without arrows) or other directionally identifiable visual signal. The source of light may for example be an LED or other light source requiring low power electrical current.

Hence, in an aircraft, lighted pathways at floor level or within armrests or running above

windows, may conveniently be installed. Where the sensors have not been activated or are below a defined threshold, the route from any seat to the nearest safe exit could be portrayed when required e.g. for test. However, should a sensor become activated the system would display the route from any given seat position to the nearest safe exit(s) and the computer/processor would be so programmed that contra-passenger flows are avoided. The system would respond to any combination of unsafe exits and/or areas within the cabin which became unsafe through one of the detected hazards so that escape routes did not transit hazardous areas outstanding the status of the exits.

By way of example, the passenger guidance means in an aircraft may be in the form of lighted directional arrows positioned over or under windows or on the armrests (which in large passenger transport aircraft are already equipped with multi-channel audio entertainment and public address circuits) pointing to the nearest appropriate safe exit. Changes in the development of the fire and its sensing may vary the route directions given, according to the analysis made by the data processor.

Optimal additional features of the invention are as follows.

The system may be self-interrogatory as to total system integrity-serviceability; that is, in accord with latest technology a diagnostic testing procedure would be built into the system to detect faults and would be periodically run to detect faults and, potential faults, thereby reducing the risk of equipment failure in an emergency.

The guidance means may employ speech synthesis to issue audible safety and/or other instructions which may not be possible due to crew incapacitation,

smoke obscuration, etc. Such speech systems may be in more than one language.

The data processor may be programmed to prevent a fire-affected door from being activated, preventing the ingress of fire hazards into the aircraft and which could not be safely used in any event.

The data processor may also activate the fire suppression system, or part of it, and may cause fire and rescue services to be alerted initiating the transmission of a locator signal and other messages.

The data processor could also be programmed to open or shut ventilators, dampers, fire doors, or open up extractors and other equipment as may be most expedient to the type of transport and hazard concerned.

In its broader aspects the invention is applicable to Channel Tunnel shuttle trains. It is planned that vehicles carried on shuttle wagons will be transported by type or class. Cars will use a double deck wagon with a plurality of cars on each level and passengers will travel with their vehicles. In the event of fire passengers will be required to move forward or rearwards to the adjoining coaches. In the case of a rapidly developing fire accompanied by smoke it may be impossible to see the origin of the fire, which could of course be central within the wagon, requiring evacuation in both directions simultaneously.

Cars carrying several passengers will normally evacuate either side of their car and it would be expedient for lighting signals to indicate safe directional information thus avoiding progressing on an unsafe route or transiting the fire source. Such lighting signals may be conveniently installed in the handrail of the wagon so as to employ the tactile sense of touch (as well as vision) and/or at floor

level and include the benefits already previously detailed.

The invention is additionally applicable to underground railways. The problems associated with underground rail services have additional considerations. The routes to platforms from street level may involve using a labarynth of passageways, corridors and cross walks, especially where one or more train services interconnect, and includes escalators, some traversing through several levels.

By way of example of the application of this invention, a fire in a ticket hall would cause directional information to become activated and produce, via the affected sensors and computer, advice to passengers at lower levels not to proceed to the surface or leave the platform, but to board transitting trains which via the rail signalling system, would be advised not to disembark passengers but only to uplift those prevented from making their escape or otherwise leaving station exits. Fire elsewhere in passageways and the like would receive appropriate directions both visually, orally including speech synthesis, as a result of the computer interpreted information from the sensors.

The conductors between the sensors, data processor and guidance means may be in the form of wire, strip, metallic strip, metallic paint, optical fibres or electromagnetic imprint, or other substance or method which will conduct electrical or other energy or signals and the structure may include a flat or raised material in which the conductors are embedded.

The conductors may cause or permit a luminous material to be enhanced and to be made readily visible by the emission of static light, flashing or pulsing light, sequentially moving light, which may

also take the form of letters, words, numbers (which may relate to exit numbers) or phrases.

The material containing the circuitry may also be combined with the light emitting material. This ensures that the installation is simultaneous and equally-quickly altered, extended or varied. It can be affixed at any position or level as to suit the application.

Other features are that the use of colour(s) is also envisaged, and also the main or subsidiary sensors may be contained in the 'run' of circuitry being installed.

The light emissions may be caused by electricity, electro-chemical, electro-magnetic frequencies or radiation, and non-visual radiations/emissions may be converted to visual emissions e.g. fluorecence or by optical activation or any combination thereof.

It will be understood that the invention is not confined to transport systems and may be used in buildings, oil rigs, submarines, ships, tunnels and mines, for example.

Central to the philosophy of the present invention is the recognition that time is critical in a fire emergency and the limited amount of time available is invariably dissipated by the involvement of human control and decision-making related to parameters and circumstances which cannot in the time limits available be properly considered and the most appropriate action determined. Moreover, often during the progress of a fire circumstances change and new decisions need to be made.

Coupled with this is the realisation that it is desirable to identify exits and exit routes by maximum sensory perception, that is by making the best use of human sensory perception. At present

evacuation in, for example, an aircraft fire is by visual means and is related to the visual distance between passenger position and exit. During the course of the fire this conception by the passenger is often lost in seconds and therefore en route signalling is highly desirable. (En route being defined as relating to the route to the nearest safe exit.) Where possible the system may be enhanced by maximum sensory means, e.g. sight, sound and touch, and for example the sequencing lights may be incorporated into a handrail or armrest with sound emitting tones (or speech synthesis) thereby using sight, sound and tactile sense.

The present invention enables instant accurate decision making and action in an emergency, without the intervention of human control. It will be understood that the veracity of the system is not dependent on a single sensor but by two or more which not only activate when defined thresholds are exceeded but also may sense departures from the norm, and progression and/or rate of progession towards an emergency or hazardous state. Signals from sensors are compared with signals from other individual sensors so that combinations of parameters which are known to indicate the presence of, or risk of, fire or explosion are recognised by the data processor. In this way the risk of false alarm is substantially reduced or eliminated. It is indeed an important aspect of the present invention that signals from two or more sensors may be compared before a decision is taken by the data processor so that the risk of a false alarm, and its undesirable consequences are minimised. Comparison may perhaps be by zones or areas, or indeed by levels within a zone. In short the sensors provide an overall picture which is interpreted by the processor, and translated into

guidance messages.

By way of example, if a temperature rise was detected by one sensor and an oxygen deficiency was detected by another sensor the data processor would interpret this as an emergency, even though the two measurements might be below what might be called the threshold points for these two sensors at which the individual readings would be regarded as conclusive that a fire existed. Similarly, if temperature rise was very rapid this would also be interpreted by the processor as an emergency situation, and the processor would not wait for the threshold of other sensors to be passed. 'Intelligence' and fast decision-making are thereby built into the equipment with a view to saving time in an emergency situation.

The sensors envisaged may be miniaturised and may respond to, for example heat, smoke, light, the hydrocarbon vapour (thus sensing a hazard before a fire or explosion) together with CO, CO_2, O_2 etc.

Advantages of the system of the invention are ease and facility of installation, provision of circuitry in a single strip and the possibility of a number of wires being reduced by the use of different transmitting frequencies, thus variation or expansion of the system can be effected at minimal cost or inconvenience.

It should be understood that the three essential components comprising the means of the present invention, namely the sensors, the data processors and the human sensory guidance means are all in themselves well-known pieces of equipment (and have accordingly not been described in great detail in this Specification). The novelty of this invention lies in the concept of combining functions of these three components in order to produce a

system which has the potential of saving many lives in emergency situations, in particular in fires involving transport vehicles, together with the ability in a preferred embodiment to eliminate false alarms, which is a principal weakness of conventional alarm systems.

CLAIMS:

1. A means of assisting the evacuation of personnel in the event of a fire or other emergency or for guiding personnel to avoid such an emergency, which means comprises a plurality of sensors positioned and adapted to detect at a plurality of locations unusual conditions indicating an emergency state, data processing means adapted to receive and analyse signals from said sensors; and human sensory guidance means activated by signals transmitted by said data processing means to provide guidance to personnel for evacuation from or avoidance of, said emergency.

2. A means for assisting the evacuation of personnel from a transport vehicle in the event of fire, and/or explosion which means comprises a plurality of sensors positioned externally and/or internally of said vehicle and adapted to detect unusual conditions of such parameters as temperature, gas or vapour concentrations, smoke density or other parameters indicating a presence of, or risk of, fire; data processing means adapted to receive and analyse signals from said sensors; and human sensory guidance means activated by signals transmitted by said data processing means to provide guidance to personnel for evacuation from or avoidance of, said emergency.

3. A means as claimed in claim 1 or claim 2 wherein the processor is adapted to compare signals from two or more of the sensors simultaneousby in order to detect an unusual condition and in order to reduce the risk of a false alarm.

4. Means as claimed in claim 2 or claim 3 when integral with said transport vehicle.

5. Means as claimed in claim 2 or claim 3 when wholly or partly in the form of a ready-made assembly or kit of parts adapted to be fitted to said transport vehicle.

6. Means as claimed in any one of claims 2 to 5 wherein said transport vehicle is an aircraft.

7. Means as claimed in any one of claims 2 to 5 wherein said transport vehicle is a railway train.

8. Aircraft whenever comprising means as claimed in any one of claims 2 to 5.

9. Railway trains whenever comprising means as claimed in any one of claims 2 to 5 or claim 7.

10. Means as claimed in claim 1 substantially as hereinbefore described.

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